RESEARCH HIGHLIGHT

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DIAGNOSING ATTIC PERFORMANCE BY SNOW- AND FROST-MELT PATTERNS

INTRODUCTION

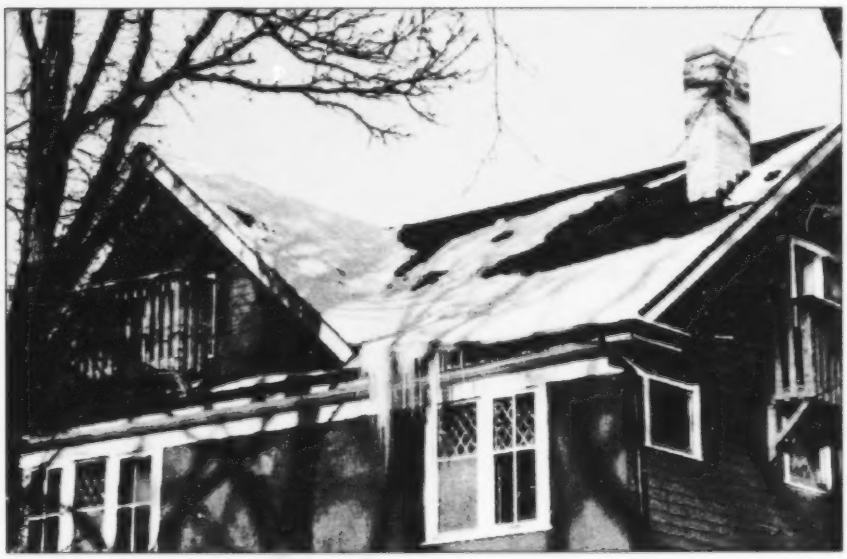
Most Canadian attics are designed to be cold in the winter. Good attic insulation and proper air sealing should result in little or no leakage of warm house air into the attic. As well, attic ventilation will help introduce cool outside air. Cool attics usually result in cool roofs, which will prevent the snow melting that creates ice dams.

When houses dump heat into their attics—through insufficient insulation or air leakage—this can result in ice damming and high attic moisture levels. Ice dams are ridges of ice on roofs that block the flow of melt water from above. They occur when the outside air is below freezing, but the attic air temperature is above freezing, melting the snow on the roof above. As the melt water runs down, it re-freezes at the cold edge of the roof, forming a ridge of ice or ice dam. Ice dams back up the melt water and keep it from draining. This water can find its way under shingles, and damage both interior and exterior finishes. If the ice eventually breaks loose and falls, it can harm people, plants or the building below. Ice dams should be avoided.

When bare roofs are covered with a heavy frost or a light cover of snow, the melting patterns will help show where heat is being lost into the attic. This is best observed in fall, when there are no deposits of snow to complicate interpretation. Early morning is the preferred viewing time, before the sun hits the roofs and melts the frost or snow. Overcast days can help. Significant house heat loss will create patterns in freshly fallen snow. The melting patterns in frost may look similar, but can be produced by much more subtle temperature variations.

This research project investigated whether significant snow- or frost-melt patterns observed in the fall are good indicators of ice damming during the middle of winter.

Here is a picture of an ice dam:



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RESEARCH PROGRAM

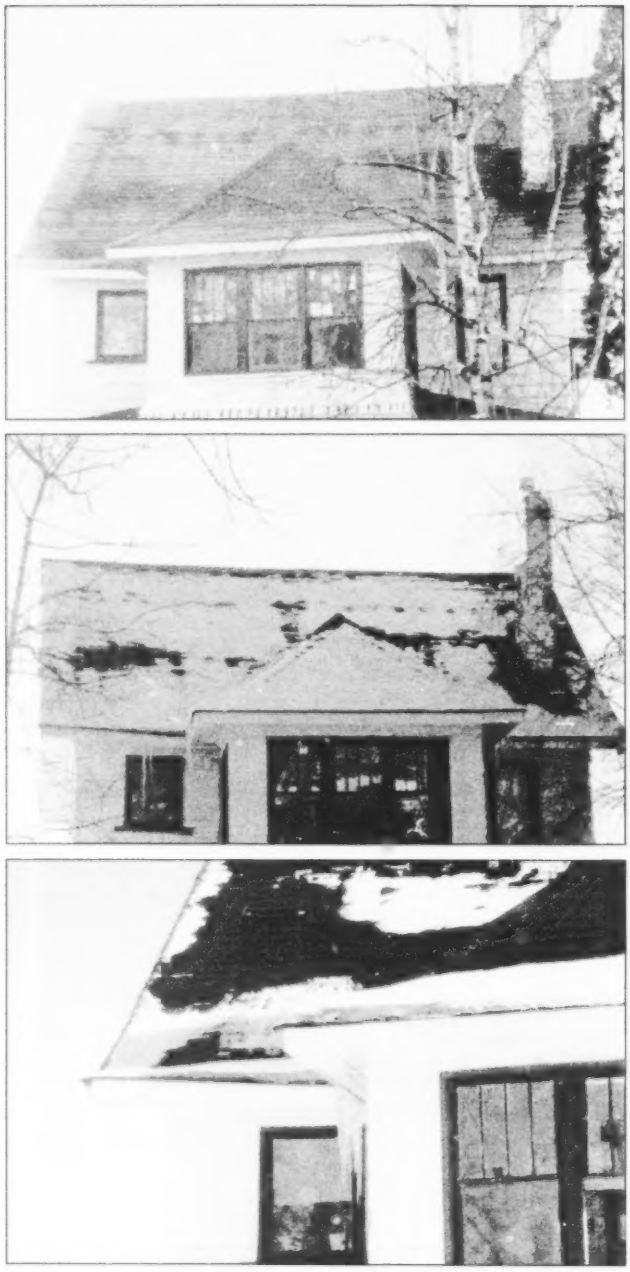
The research program seemed simple at the outset. Contractors in three cities, Peterborough, Toronto and Winnipeg, went out in the fall and early winter of 2001 to photograph interesting melt patterns on roofs, and then waited for a suitable ice damming winter season to occur. Winters that cause ice damming are quite rare. They usually consist of periods of deep snow accumulation, with sustained temperatures moderately below freezing. Generally, extended thaws or extremely cold temperatures will not create significant ice dams. It was not until late in the winter of 2003/2004 that ice-damming conditions occurred in Winnipeg, and the "after" photos of the same houses were taken. Note that all photographs were taken without interaction with the householders—in effect a drive-by research project. Inspections of the houses and attics would have contributed to the analysis of the melt patterns, but were beyond the scope of the research.

In retrospect, there are two flaws with this research design. First, it would have been more efficient to photograph houses with ice dams, in a winter prone to ice dams, and then to record the roof melt patterns the following spring or fall. Secondly, it would have been best to match each house with ice damming with a similar control-house without ice damming, and then to compare the roof melt patterns of both the case house and the control house to see if there were a significant difference.

RESEARCH RESULTS

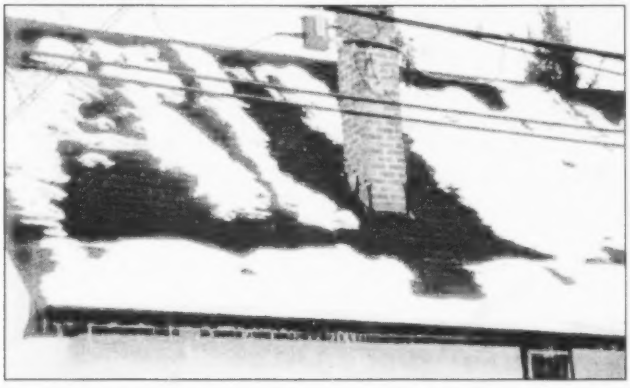
There are many interesting roof melt patterns and it is clear that some of them produce local ice damming. The sloped sections of half-storey roofs are a common example. Other melt patterns are sometimes challenging to analyze.

Example 1: Common melt patterns on half-storey roofs



The pictures above show melt patterns common to half-storey roofs. You can see that in both, the frost and snow-melt patterns, there is heat loss on the sloped part of the top storey roof. Ice dams result, as shown by the last photo taken in March.

Example 2: Melting patterns in specific locations



This is another half-storey house, with melt patterns in the sloped roof and in the vicinity of the chimney.

Example 3: Knee wall and slope melt patterns

This photo shows what appears to be a one-and-a half storey house with a side addition. In the addition on the left, the knee wall area is poorly insulated but the slope above is cold. In the main house, however, the knee wall is well insulated but the slope is too hot and melts off the snow. Without entering the house, we cannot determine the exact construction details.

Example 4: Half storey with snow depth differences

This house clearly shows areas that are better insulated by the depth of the remaining snow on the roof surfaces. Note that the unheated front porch roof is still deep in snow. Icicles are evident on the left side of the house.

Example 5: Frost-melt patterns and insulation levels

Here is another half-storey house with clear delineation between well-insulated section of the roof and the section that is warmer.

Example 6: Melt patterns over exterior walls

This house shows heat loss over the exterior walls and an accumulation of ice on the side roof. Ice dams are apt to appear first in the roof valleys, which have to handle a higher proportion of the melting snow than the rest of the roof.

In contrast, the three photos below show an example of a snow-melt pattern on a roof not affected by hot spots. There is no ice damming and typically the snow melts first on the perimeter, with the last snow remaining in the centre of the roof.

Example 7: Snow-melt pattern on a roof not affected by hot spots

HOMEOWNERS AND INDUSTRY IMPLICATIONS

This project was partially successful. The original intent of this research was to demonstrate that a roof without large melt patterns would not produce ice damming and that portions of the roof that quickly melt frost and snow will result in ice dams in that location. Frost-and snow-melt patterns can be used to indicate heat losses from the house, however the photographic proof is not yet sufficient to substantiate these hypotheses.

If you experience a problem with ice damming, observing melt patterns in the fall can help you locate the heat losses that may be a factor in ice dam creation. Add insulation or air seal in the vicinity of the melt patterns.

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Housing Research at CMHC

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